COMMUNICATING SCIENCE EFFECTIVELY

Ben Longstaff and Caroline Wicks
EcoCheck (NOAA-UMCES Partnership)

Ben Fertig
Integration and Application Network
(University of Maryland Center For Environmental Science)

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

CHESAPEAKE EcoCheck
Assessing and forecasting ecosystem status
NOAA
University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
www.eco-check.org

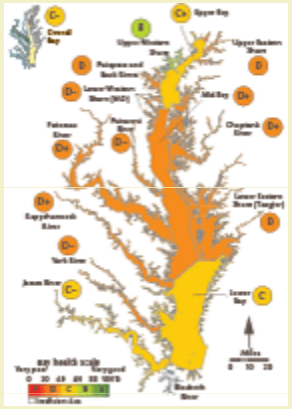
Integration & Application Network

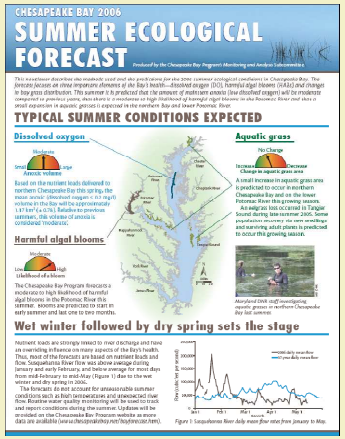
Our background - Integration and Application Network (IAN)

- **An initiative of the University of Maryland Center for Environmental Science**
- **Synthesize and interpret new scientific findings to develop an integrated picture**
- **Scientists interested in solving, not just studying environmental problems**
- **Led by Dr. Bill Dennison**

Our background: EcoCheck

- **Partnership between NOAA and the Integration and Application Network (IAN)**
- **Aim: "*enhance and support the science, management and restoration of Chesapeake Bay through the integration of geographically detailed assessments and forecasts.*"**
- ***Effective science communication is essential element of our aims***





Teaching science communication

- **IAN / EcoCheck running science communication courses for over 4 years**
- **Based on experience and theory →Scientist practicing science communication**
- **Conducted courses nationally and internationally**
- **Published a book, and a second related book is on the way.**

An Introduction to effective science communication

Ben Longstaff

South Carolina Science Communication Course
April 7-10, 2008

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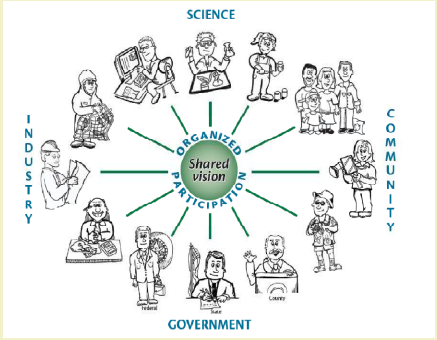
Integration & Application Network

Objectives

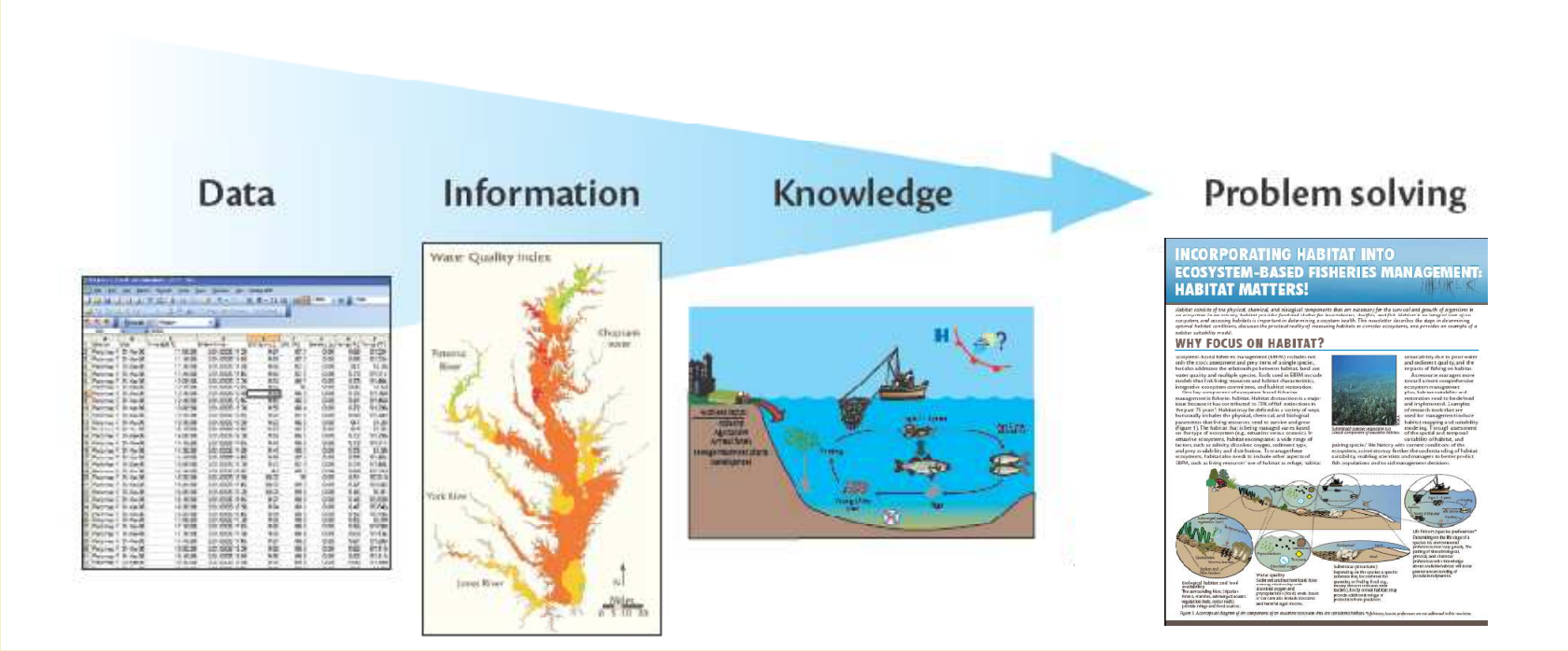
- ***Communication strategy overview***



- ***Provide*** **some overarching science communication principles**

- ***Establish*** **an underlying philosophy for science communication**

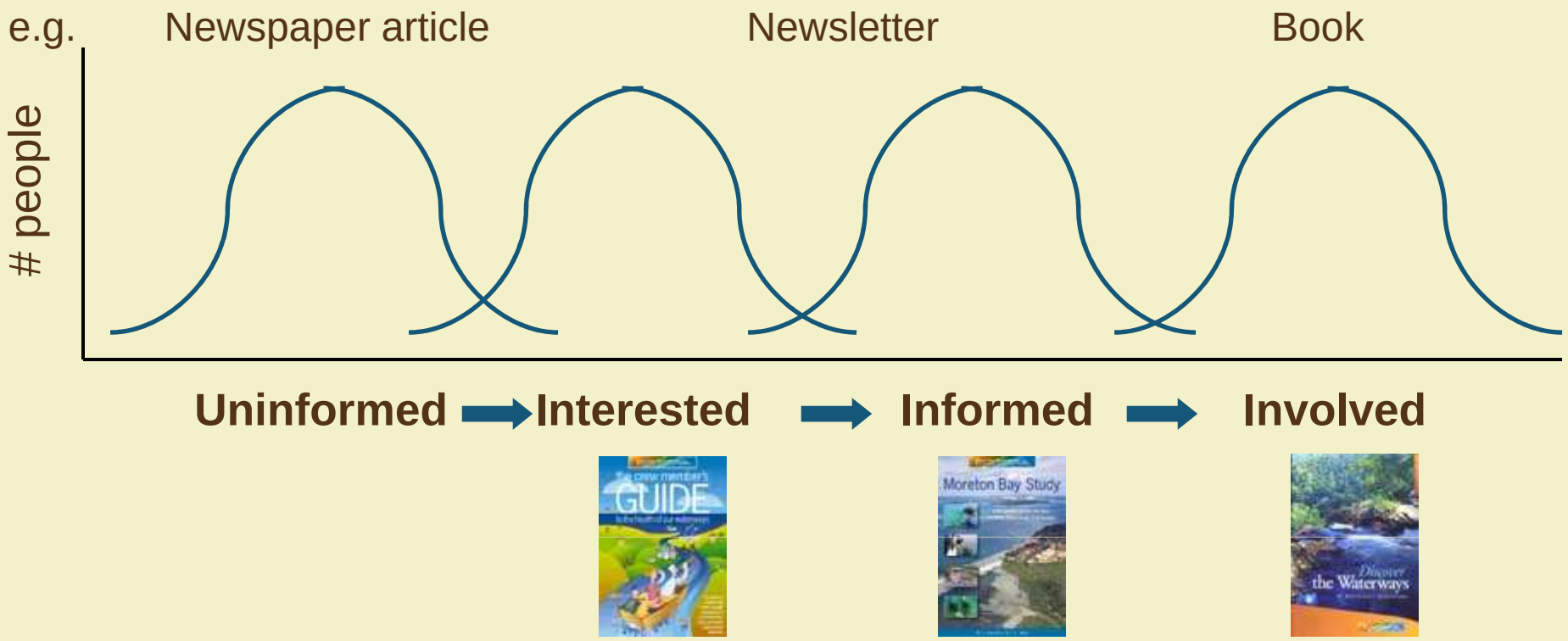
Science communication: one of the final yet most important steps



You are not doing anything if nobody knows what you are doing

Science communication to create change

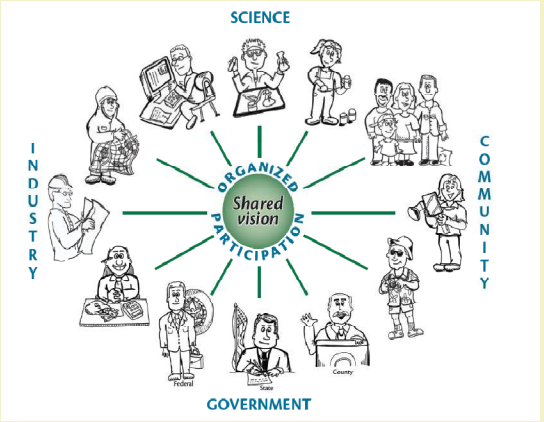
- **Target communication to audiences level of engagement**
- **Aim to increase level of engagement**



Developing a communication plan

A few principle to consider:

- Your target audience
- Appropriate communication vehicle/s
- Key messages
- Packaging and delivering your message
- Completion timeframe



Determining your target audience

Determining the target audience

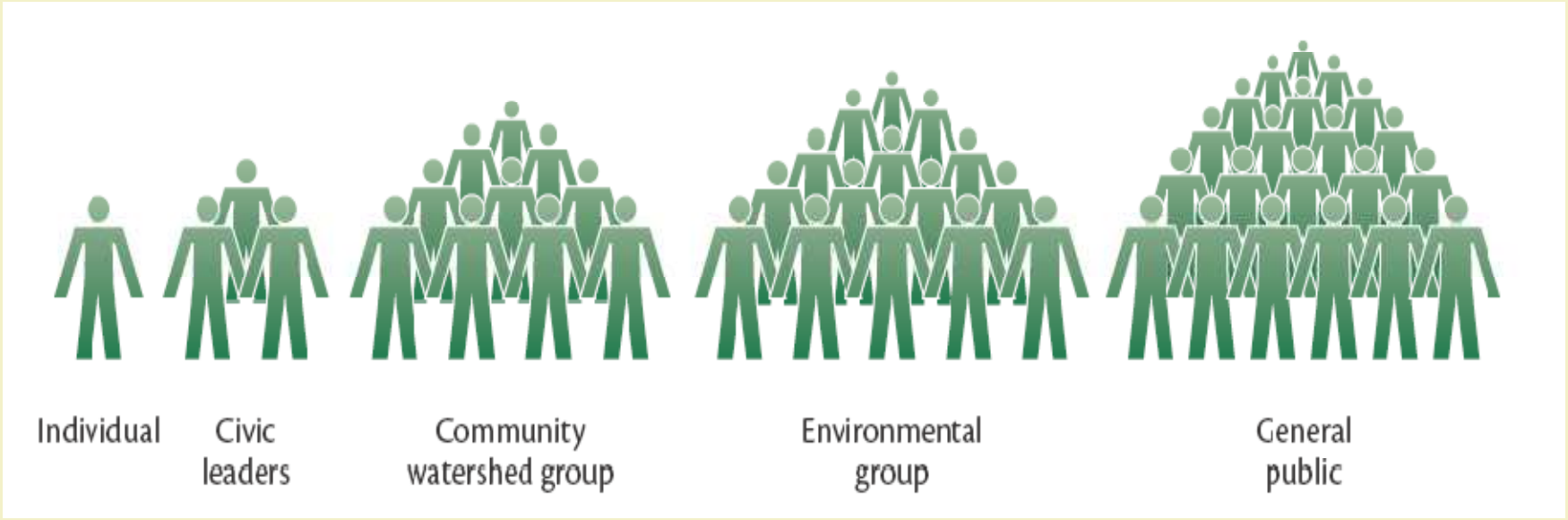
- Who needs to hear what I am saying?
- Who will find my information useful?
- Who can use my information to better do their job?
- Who can use my information to change things?

Different target audiences have different sizes, and consequently require different communication techniques.

Determining your target Audience

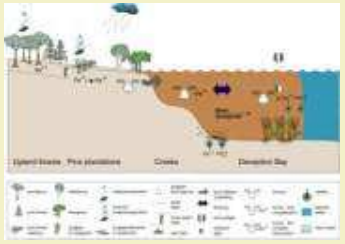
Use science communication principles to target a broad audience

e.g. synthesis, visualization & context

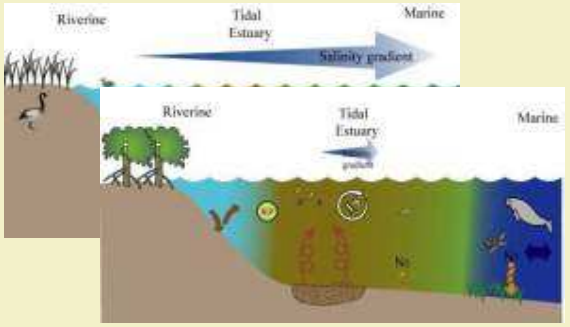


Good science communication can make you a better scientist

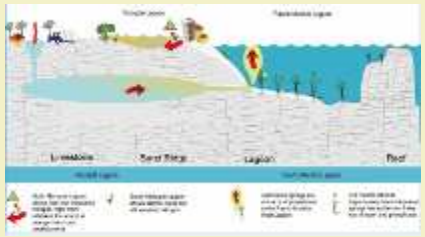
Completeness
Envisioning the ‘story’ can lead to comprehensive research program



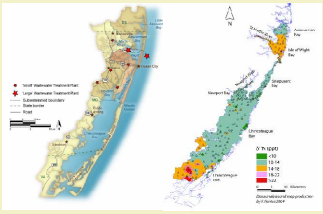
Context
Identifying the linkages and developing comparisons can provide important insights



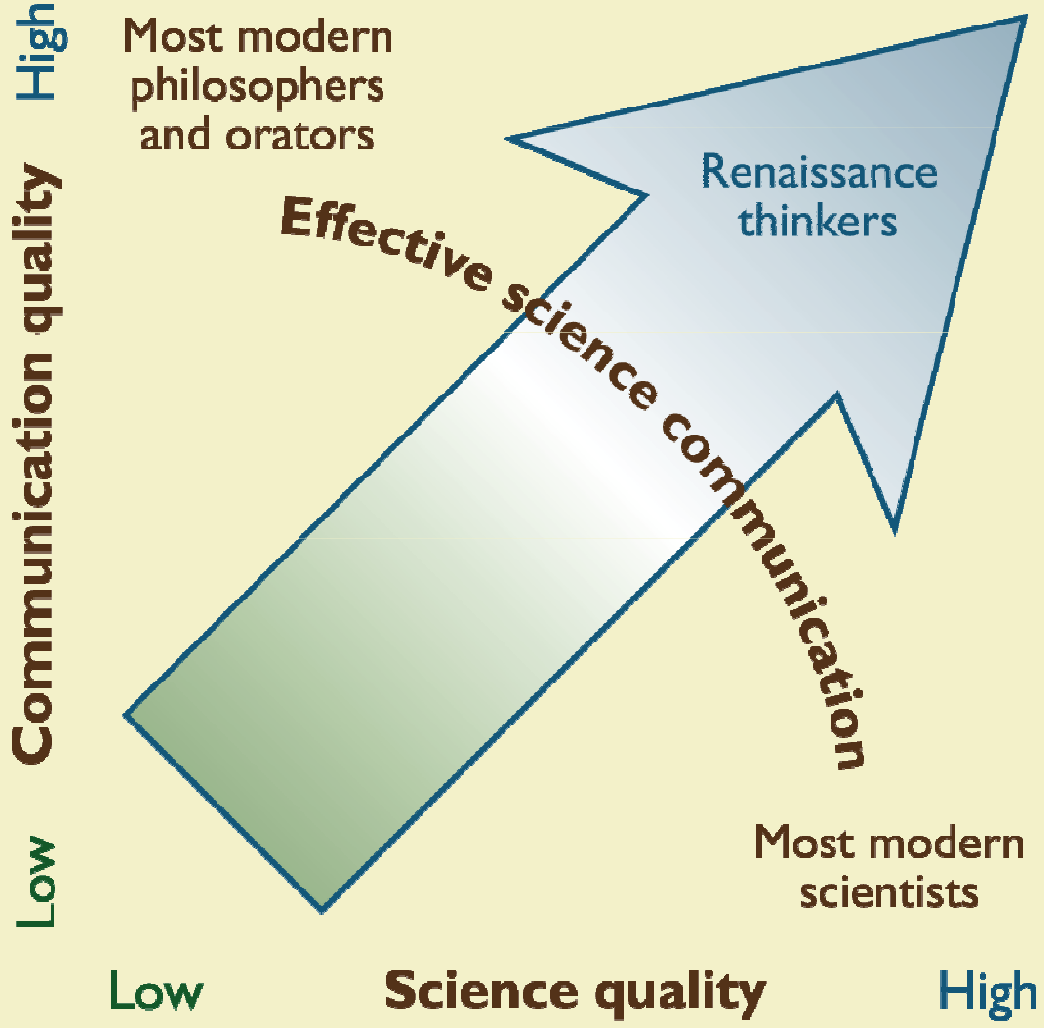
Clarify
Having to identify the fundamental message removes vagueness in thinking



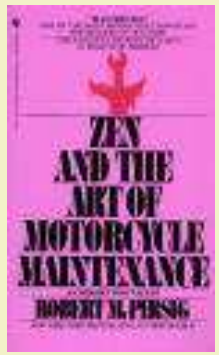
Synthesis
Combining and comparing different data sets or approaches can lead to insights



Good science communication requires attention to both the science and the presentation



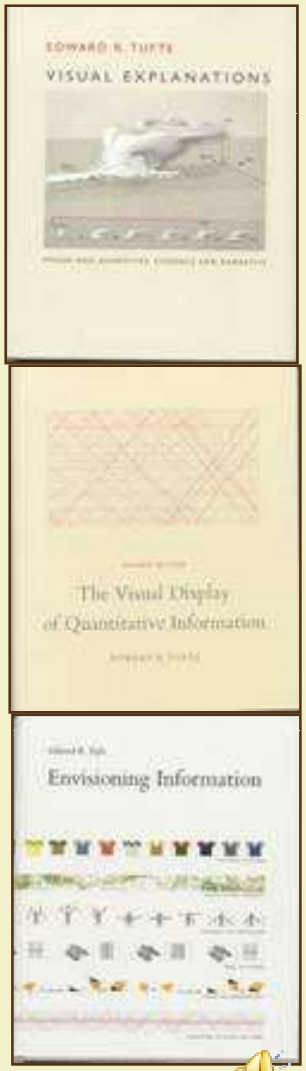
"What you've got here, really, are two realities, one of immediate artistic appearance and one of underlying scientific explanation, and they don't match and they don't fit and they don't really have much of anything to do with one another. That's quite a situation. You might say there's a little problem here."



Robert Pirsig, 1974

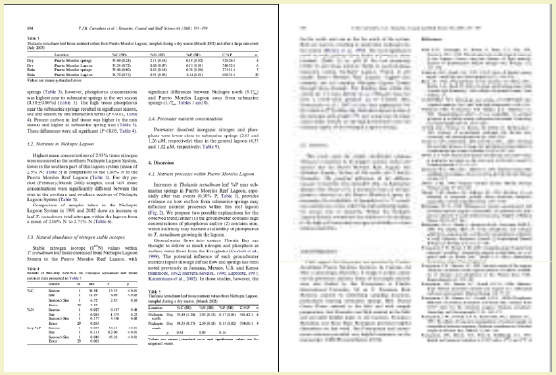
Principles of Analytical Design; E. Tufte

- **“Don’t get it original, get it right”**
- **Integrate word, image, numbers**
- **Include documentation (data sources)**
- **Content-driven; presentation enables thinking**
- **Put important comparisons adjacent in space**
- **Use small multiples (maximize content variation; minimize style variation)**
- **Audiences are precious (know your content; respect your audience)**
- **Use humor, memorable hyperbole**
- **Preparation: Practice, practice, practice; develop better content**

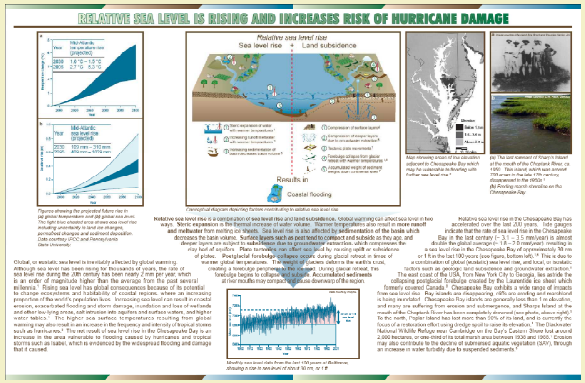


There are differences between science writing & science communication

- Getting it right
- Providing scientific context (references)
- Text > graphics
- Peer audience
- Mostly black and white
- Authorship exclusive
- Focus on results and interpretation

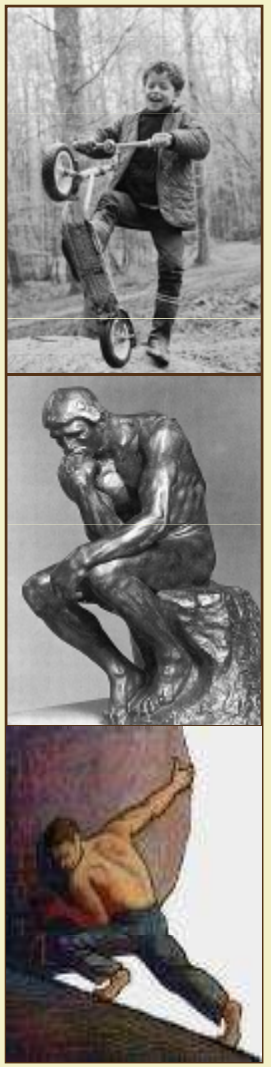


- Getting it done
- Providing societal context (examples)
- Text ≈ graphics
- Broader audience
- Full color
- Authorship inclusive
- Focus on conclusions and recommendations



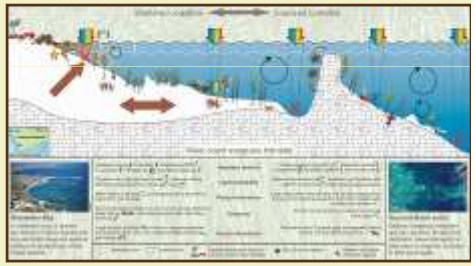
The 'zen' of science communication

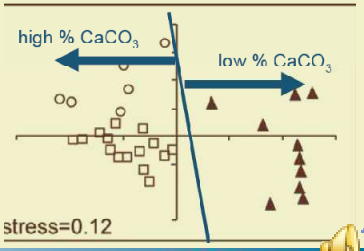
- *Enthusiasm* counts: get excited
- Give yourself adequate *quality time*
- *Feedback & revision* essential: seek it out



The art of science communication

- **Conceptual diagrams: context and synthesis**
- **Maps: geographic context and information-rich**
- **Photos: describe methods, study site description, processes and relevance**
- **Video clips: capture system dynamics**
- **Tables and figures: scientific data**

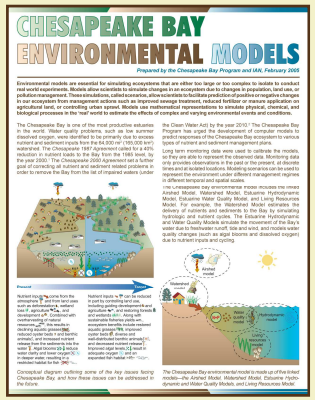




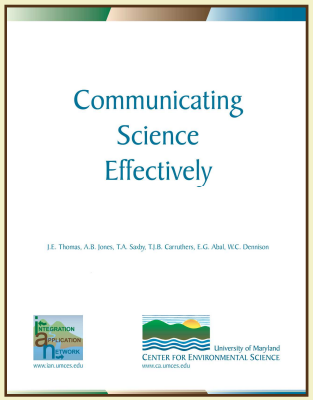
Principles of Effective Science Communication

Develop a consistent style and format

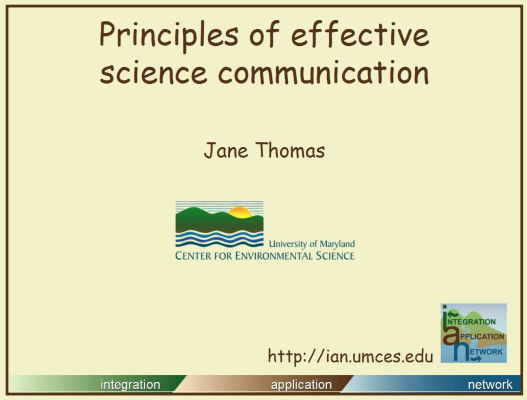
- ***Within* products, and also *between* products**
  - Newsletters, presentations, websites, books
- **Train your audience**
- **Use *Master Slide* or *Master Page* functions to ensure consistency**



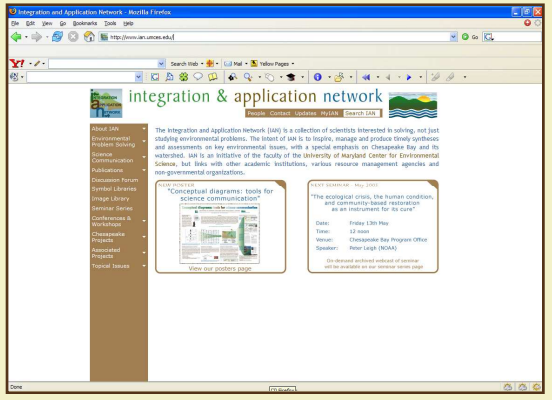
Newsletter



Book



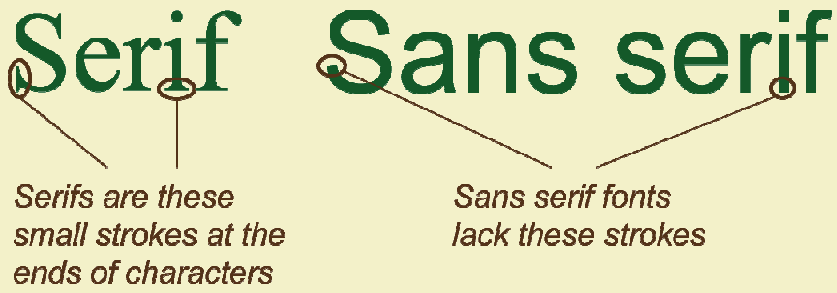
Presentation



Website

Typography is the art of words

- **Spelling and grammar**
- **There are two types of fonts – serif, and sans serif**



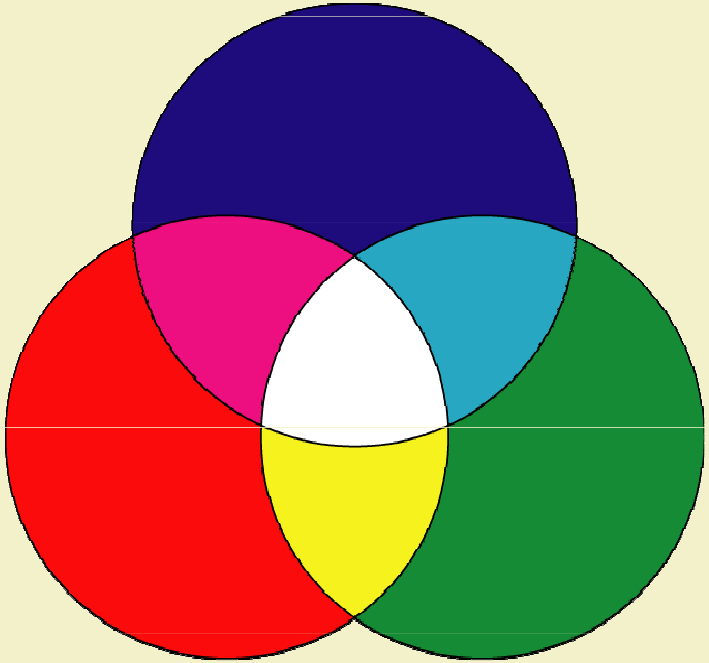
Serif fonts	Sans serif fonts
Times New Roman	Arial
Garamond	Century Gothic
Palatino	Helvetica

This is a serif font. Which of these fonts is easier to read?

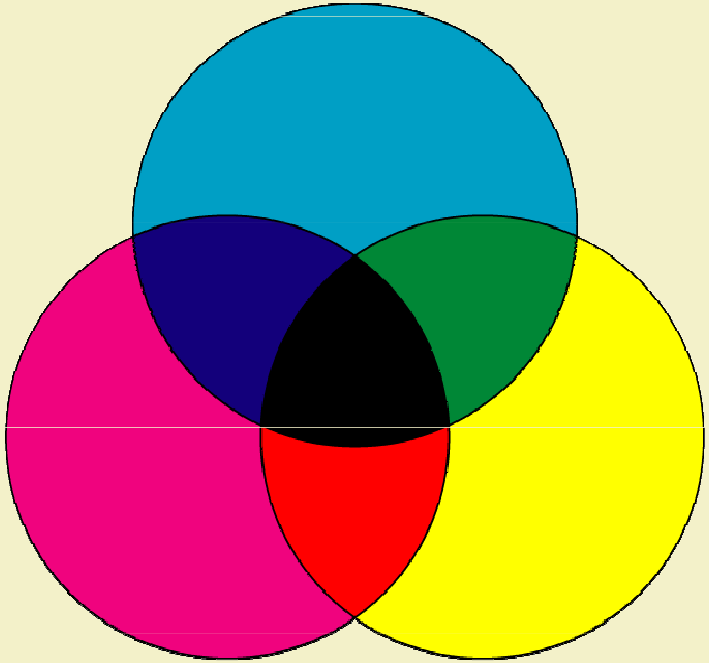
This is a sans serif font. Which of these fonts is easier to read?

- **Sans serif fonts are more readable from a distance**

RGB vs. CMYK



- Red, Green, Blue
- Transmitted light (presentations, websites)
- Mixing the colors results in white light
- Absence of color results in black



- Cyan, Magenta, Yellow, blacK
- Printed ink (posters, newsletters)
- Mixing the colors results in black ink
- Absence of color results in white (or the background color)

Use the right resolution

- Resolution differs between different media
  - Printed products need 300 DPI
  - Presentations and websites need 96 DPI
- Using the right resolution for your communication will ensure your graphics are clear, and will also help with managing file size

Image types and formats

- *Raster/bitmap graphics* (photos, scans; resolution-dependent)
  - TIFF CMYK or RGB; large file size due to lossless compression
  - JPEG CMYK or RGB; small file size due to lossy compression
  - GIF RGB; small file size due to less colors; use on websites; transparency
  - PNG RGB; relatively new format; transparency
  - EPS CMYK or RGB; usually just for spot color images
- *Vector graphics* (created using software; resolution-independent)
  - EPS CMYK or RGB; maintains resolution independence

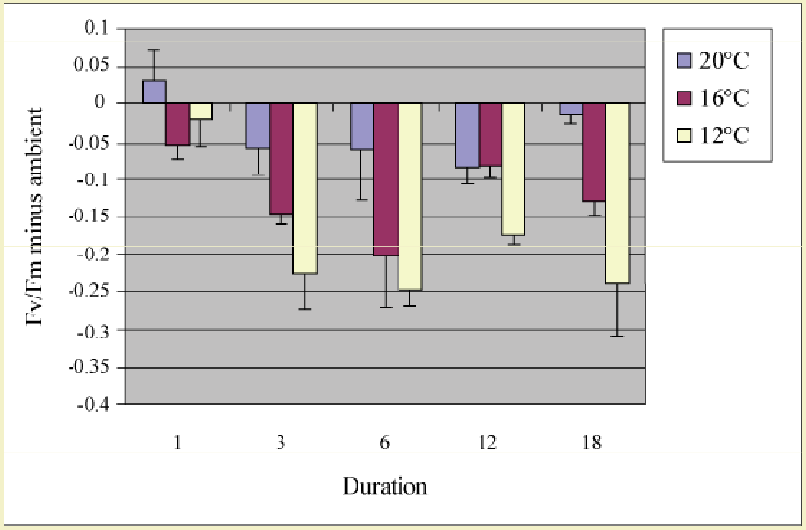
Image types and formats

Destination	Resolution	Color format	Image format
Print	300 DPI	CMYK	EPS, TIFF, JPG
Screen	96 DPI	RGB	PNG, GIF, JPG

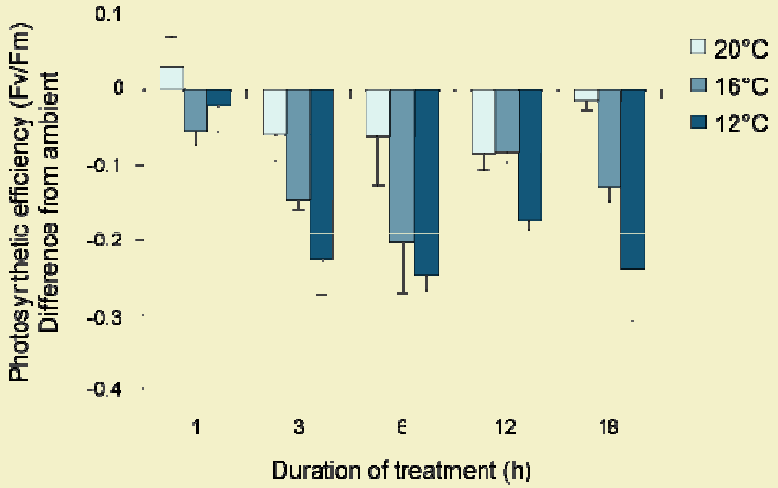
- **It is worth the time and effort to create graphics for both printing and presentations**
  - Optimize file size
  - Once you have the different formats, you can use them over and over again

Graph formatting makes all the difference

Bad (or no) formatting



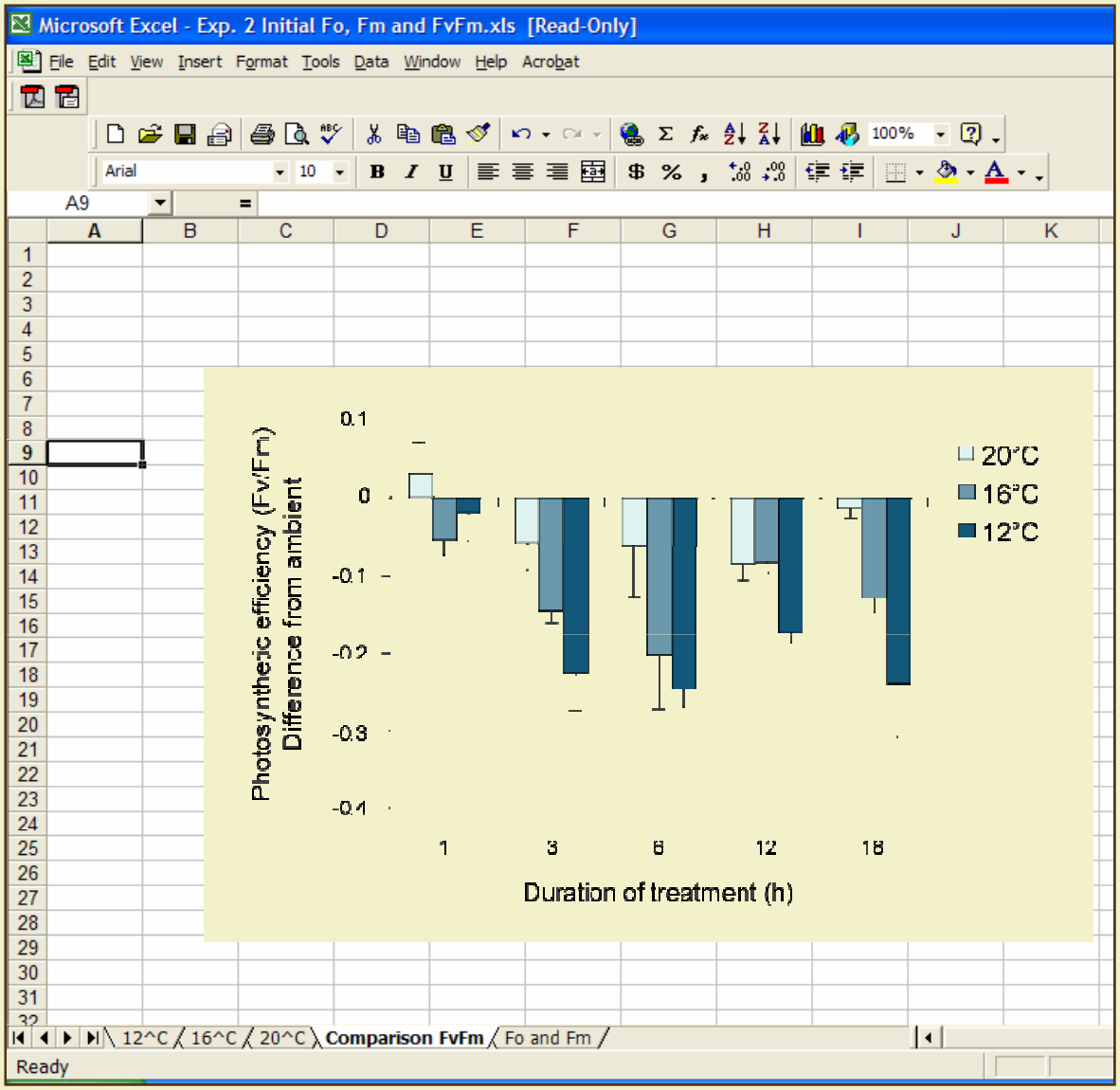
Good formatting



- **Boxes, gridlines and white background distracting**
- **Axes label too technical, too many tick marks on y axis**
- **Excel default colors**

- **Transparent background, no boxes or gridlines**
- **Large, clearly-labeled axes, with units at end**
- **Contrasting colors**

Get them right in data software first



- Use colored background box to facilitate color matching
- Remove graph background
- Remove grid lines, borders & unnecessary legends (i.e. if only one data series)
- Clean up extra tick marks and increase intervals between marks
- Label axis with title and units
- Select text and right click to format (subscript, etc)
- Delete colored background

Try to avoid tables …

Region	EHI	Region area (km^2)	% area region	DO	Secchi	Chl a	TP	TN	$\delta^{15}N$
Upper Patuxent	**0.21**	**21**	**13**	**0.66**	**0.00**	**0.34**	**0.00**	**0.09**	**0.15**
Middle Patuxent	**0.52**	**61**	**37**	**0.91**	**0.00**	**0.26**	**0.28**	**0.87**	**0.80**
Lower Patuxent	**0.48**	**53**	**32**	**0.99**	**0.00**	**0.37**	**0.18**	**0.47**	**0.85**
Mouth Patuxent	**0.58**	**30**	**18**	**1.00**	**0.00**	**0.38**	**0.93**	**0.53**	**0.62**
Patuxent Overall	**0.48**	**165**	**100**	**0.92**	**0.00**	**0.33**	**0.33**	**0.58**	**0.70**
Upper Choptank	**0.20**	**16**	**4**	**0.26**	**0.00**	**0.24**	**0.00**	**0.00**	**0.71**
Middle Choptank	**0.26**	**88**	**24**	**0.95**	**0.00**	**0.04**	**0.06**	**0.06**	**0.42**
Lower Choptank	**0.44**	**160**	**43**	**1.00**	**0.00**	**0.24**	**0.59**	**0.39**	**0.40**
Mouth Choptank	**0.49**	**109**	**29**	**1.00**	**0.00**	**0.62**	**0.53**	**0.38**	**0.42**
Choptank Overall	**0.40**	**373**	**100**	**0.96**	**0.00**	**0.30**	**0.42**	**0.30**	**0.43**
Cape Charles City	**0.75**	**N/A**	**N/A**	**nd**	**0.75**	**0.75**	**0.63**	**1.00**	**0.63**

… or format them right

Region	EHI	Region area (km^2)	% area region	DO	Secchi	Chl *a*	TP	TN	$\delta^{15}N$
Upper Patuxent	0.21	**21**	**13**	**0.66**	**0.00**	**0.34**	**0.00**	**0.09**	**0.15**
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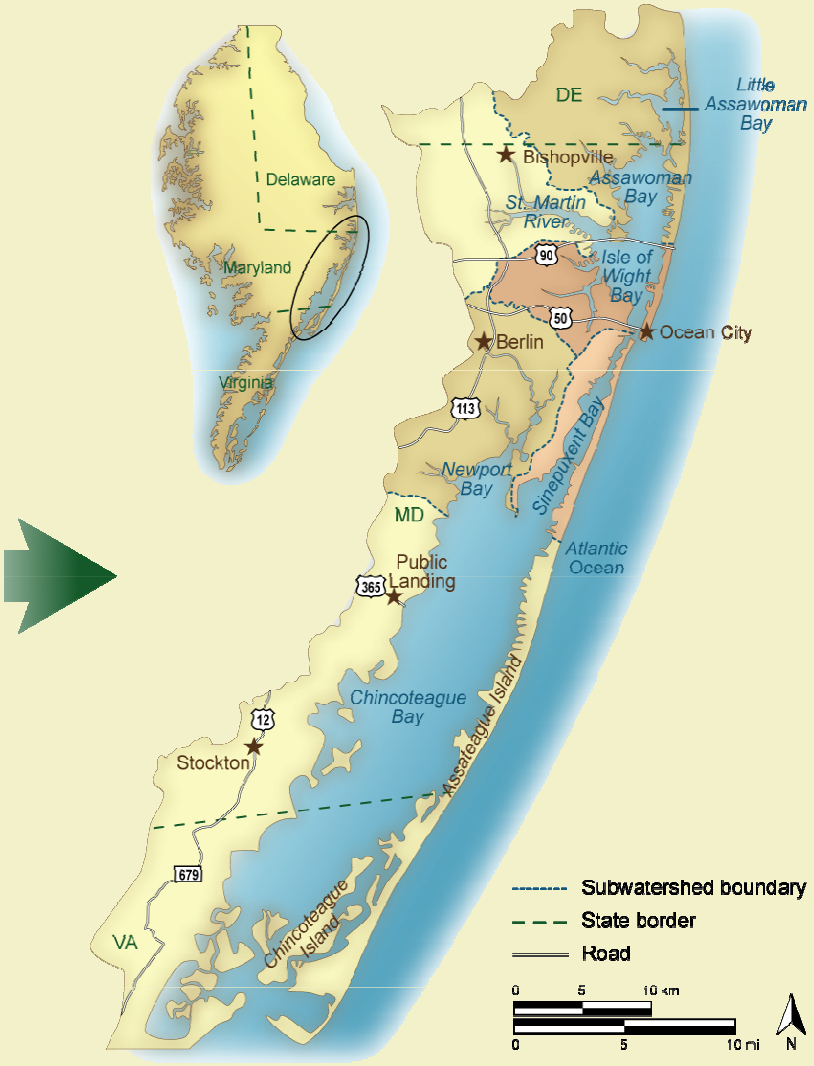
Cape Charles City	0.75	**N/A**	**N/A**	**nd**	**0.75**	**0.75**	**0.63**	**1.00**	**0.63**

- **No vertical lines, minimize horizontal lines, use color and fonts to emphasize data**

Format maps to include more information



Crop, align, and label photos carefully

X

vs

✓

Accurate cropping

Photos that are well chosen, cropped, aligned, distributed evenly and annotated provide information on methods, study site, description & relevance

X

✓

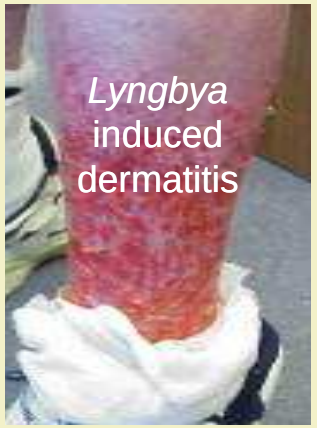
Pay attention to alignment & overlapping

X

X

Clear labeling of photos

✓



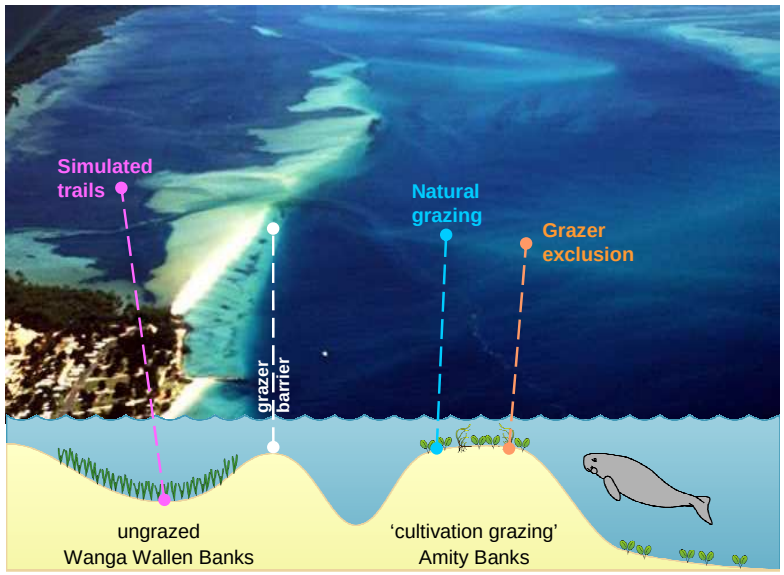
✓

Lyngbya induced dermatitis

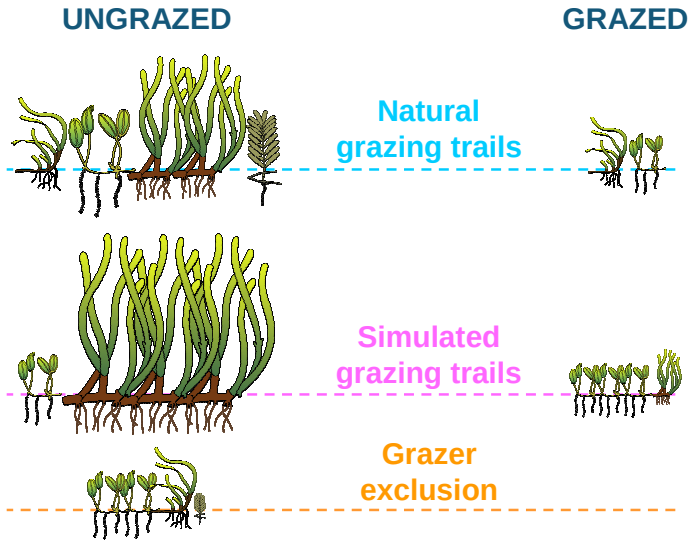
Lesson: bad science communication = skin lesions

Combining all visual elements

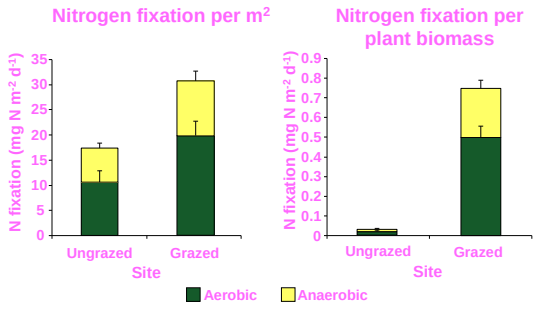
Site selection



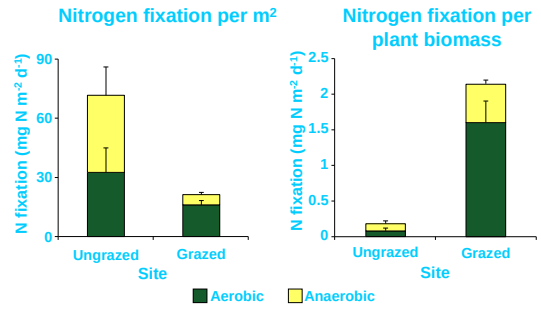
Community composition & morphology



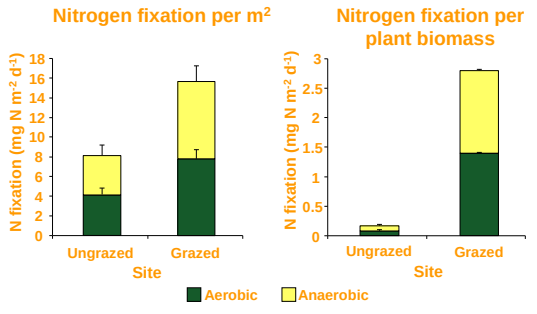
Nitrogen fixation
Simulated grazing trails



Nitrogen fixation
Natural grazing trails



Nitrogen fixation
Grazer exclusion



- **Set up color pattern early on and train the audience**

IAN Principles of science communication

- **Provide synthesis, visualization & context**
- **Get real; relate to audience – big picture to local relevance**
- **Simplify terms but not content (don't *dumb it down*, do *raise the bar*)**
- **Assemble self-contained visual elements**
- **Consistent *style* and *format***

IAN Principles of science communication

- **Lose the jargon, dude**
- **Define all terms , e.g. SE = Standard Error**
- **Minimize AU (Acronym Use)**
- **Engage audience: prepare for and invite questions**
- **Use color, but use it judiciously**